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# (54) Cementitious Board

(57) A building board, which can be produced continuously and cut into panels or tiles for use in suspended ceilings, comprises a body of cellular or porous, set cementitious material having a density between 300 and 500 kg $m^{-3}$ and a porous, inorganic fibre sheet partly or completely embedded in at least one face of the board. The product preferably has a fibre sheet partially or completely embedded in each of its opposite faces and may contain fibrous reinforcing material dispersed throughout the cementitious mass. The board can be readily worked to form rebates or kerfs along one or more edge. The preferred cementitious material is gypsum and the preferred fibre sheet is resin-bonded glass fibre tissue having a weight of from 35 to 80 g $m^{-2}$.

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# CEMENTITIOUS BOARD

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The present invention relates to lightweight cementitious board which is suitable, for example, for use in ceilings.

The utilisation of gypsum in board or tiles for suspended ceilings, has been known for a considerable time. One example can be found in our GB 797 449, in which board formed from a foamed aqueous mixture of gypsum plaster, rockwool and water-soluble thermosetting resin, is subdivided into tiles or panels. Products of this kind are heavy and are therefore cumbersome to handle and install and require strong supporting systems.

On the other hand, reinforced gypsum board can be produced as described in our GB 2 053 779 by depositing a gypsum plaster slurry between two layers of glass fibre tissue, and vibrating the surfaces until a continuous film of gypsum is formed on at least one face of the board. The resulting board is outstanding for applications where its hard surface and excellent fire resistance are desirable but, having a density in the region of 1000 kg $m^{-3}$, is unsuitable for some applications.

The present invention seeks to provide a lightweight board which avoids the disadvantages of earlier proposals, but which can be manufactured continuously on a high speed production line.

According to this invention, this object is achieved by a board product which comprises a body of cellular or porous, set cementitious material having a density between 300 and 500 kg $m^{-3}$ and a porous, inorganic fibre sheet partly or completely embedded in at least one and preferably in both faces of the board. The preferred density range below 450 kg $m^{-3}$.

The surface provided by a partly embedded tissue has an attractive appearance and exhibits some acoustic properties, although acoustic properties are not a primary object of this invention.

When continuously produced, the board may be cut into short lengths or tiles, and the edges of such cut elements may be machined to provide particular edge profiles, openings to receive fittings and the like. The mixture preferably includes fibrous reinforcing material dispersed through the cementitious mass. One example of such fibrous reinforcement is cellulose fibres, which improve the

machineability of the product. The strength of the board may also be increased by the inclusion of chopped inorganic fibre in the cementitious mass. Typical levels of these reinforcements are up to 0.5% by weight chopped glass fibre based on the weight of plaster and up to 1% by weight ground paper fibre, although higher levels can be used.

Although there is no necessity to include a polymer or synthetic resin in the board composition, such additives may be included to confer additional strength on the board, especially at very low densities. When such strengthening additions are made, there is the possibility of omitting the tissue from the surface of the board which constitutes the back face. Resin additions are particularly valuable when the board is to be rebated or kerfed, because it strengthens the residual edge profile. It is also possible to apply resin superficially to the edges of the board, for example by spraying or brushing, in order to minimise the risk of damage during handling.

Other components of the composition may include a setting accelerator or retarder as appropriate, while the inclusion of tartaric acid increases the sag resistance of the board in accordance with our GB 1 226 333. Superplasticisers may be added to reduce the water demand of the plaster employed. These may be, for example, of the sulphonaphthalene or modified melamine formaldehyde types. In the latter case, the additive may also have some strengthening effect, and resins or polymers may be included specifically for this purpose, as already mentioned.

Although various forms of cementitious material can be used, including various forms of dehydrated or partially dehydrated natural or synthetic gypsum, including desulphogypsum, or fast setting siliceous cements, the preferred cementitious starting material is calcium sulphate hemihydrate.

The inorganic fibre sheet employed at the surface of the board is preferably a non-woven tissue, and more especially a resin bonded glass fibre tissue having a weight of from 35 to 80 g $m^{-2}$. In preferred embodiments a glass fibre tissue is employed which has a weight in the range 46 to 54 g $m^{-2}$ and a porosity of 3.2 to 3.6 mm $H_2O$.

The board has a number of important advantages. The low density means that the weight per unit area is low, typically up to 6.5 kg $m^{-2}$ for a gypsum board of 13 mm thickness, which has important advantages in handling as well as in the construction of ceilings. This light weight is achieved without an unacceptable reduction in strength. The modulus of rupture is approximately double that of a known mineral fibre tile. The sag resistance of the board according to the invention is about four times that of the mineral fibre tile.

The board according to the invention has good fire performance. A structure composed of boards according to the invention laid in a steel grid has shown resistance to fire over periods up to one hour. The combustibility of the product is not significantly affected by the inclusion of a small proportion of paper fibre to improve the machineability of the board, as mentioned above.

The board according to the invention is cheap to produce by virtue of economies both in materials and in processing. It readily accepts many surface finishes, such as paints and other surface coatings.

The board according to the invention is conveniently formed from a highly foamed slurry of the cementitious material in water, in which air is entrapped with the help of a surfactant foaming or air-entraining agent. The board can be produced continuously by pouring the slurry onto a layer of the fibrous sheet on a flat conveyor surface, such as a moving belt. If a fibrous sheet is to be incorporated in each face of the board, a further layer is applied to the upper surface of the slurry, which then passes beneath a gauging device such as an upper conveyor surface, which determines the thickness of the resulting board The slurry is then allowed to penetrate the sheet before the cementitious material sets. This method contrasts with that of GB 2 053 779 in that vibration of the top conveyor belt is preferably avoided in the present invention because it has the effect of reducing the degree of foaming of the slurry and undesirably increasing the density of the product. Furthermore, when the top belt is not vibrated there is imperfect penetration of the slurry through the top sheet which, especially where a fibrous tissue is employed, results in a pleasing

fissured effect.

The following is an example of the production of lightweight gypsum board according to the invention and the properties achieved in the resulting product.

A foamed gypsum plaster slurry is prepared by aerating a mixture of the following constituents:-

| | | |
|---|---|---|
| Hemihydrate plaster | : | 1000 parts by weight |
| Chopped glass rovings | : | 3 parts by weight |
| Gypsum mineral accelerator | : | as required to achieve appropriate setting time |
| Ground paper fibre | : | 7 parts by weight |
| Air-entraining agent | : | 3.5 parts by weight |
| Water | : | 1290 parts by weight |

The slurry, foamed to the degree required for the desired final density, is spread on a sheet of resin bonded glass fibre tissue of 50 g $m^{-2}$ initial weight, which has a porosity of 3.4 mm $H_2O$, the tissue advancing continuously on a lower conveyor belt. A further layer of similar tissue is applied over the slurry as it passes beneath an upper conveyor belt. No vibration is applied to the belts with this mixture but the slurry is allowed to penetrate the fibrous tissues.

The board when initially set is removed from the conveyors, cut into lengths and dried. It is then cut into tile blanks, preferably somewhat over width, the blanks being passed through a bevelling machine to profile the edges as appropriate for the systems in which they are to be used. The edges of the tiles are coated, for example with vinyl acrylate, to improve the strength and impact resistance. A diluted flame retardant paint is also coated on the decorative face and edges of the tile, preferably while the edge coating is still wet.

The following are the properties of a typical product of the method just described:-

| Property | Tile of Invention | Mineral Fibre Tile |
|---|---|---|
| Thickness | 12.5 mm | 15 mm plus |
| Density | 430 kg $m^{-3}$ | 430 kg $m^{-3}$ |
| Modulus of rupture | 2.68 N $mm^{-2}$ | 1.39 N $mm^{-2}$ |
| Sag (600 mm centres, after 28 days at 90% RH, 20°C) | 1.28mm | 5.05mm |

CLAIMS

1. Building board which comprises a body of cellular or porous, set cementitious material having a density between 300 and 500 kg $m^{-3}$ and a porous, inorganic fibre sheet partly or completely embedded in at least one face of the board.

2. Board according to claim 1 wherein the density is below 450 kg $m^{-3}$.

3. Board according to claim 1 or 2, having a sheet as aforesaid partly or completely embedded in each of its opposite faces.

4. Board according to claim 1, 2 or 3 wherein the cellular or porous body includes fibrous reinforcing material dispersed throughout the cementitious mass.

5. Board according to claim 4, wherein the fibrous reinforcement comprises cellulose fibres and/or chopped inorganic fibre.

6. Board according to any preceding claim, wherein the cementitious material is gypsum.

7. Board according to any preceding claim, wherein the inorganic fibre sheet is a resin-bonded glass fibre tissue having a weight of from 35 to 80 g $m^{-2}$.

8. Board according to any preceding claim formed with one or more rebated or kerfed edge.

9. Board according to claim 8, additionally containing a resin in admixture with the cementitious material.

10. Board according to claim 8, in which a resin is applied externally to one or more edges.